than we yet do, to the cultivation of this vegetable; as, independently on its beauty, it is so well calculated to lessen the numbers of a most common and troublesome insect.

No. XVII.

On the Process of claying Sugar. By Jonathan Williams. Esq.

Read March 4th, 1803.

The art of refining sugar consists of three operations; the first is *clarification*, so well known in Pharmacy, by the addition of a coagulable substance, and a gentle application of heat. The second is *chrystalisation*, that is, evaporating the superabundant water by a strong application of heat; the third is merely washing away the colouring mucus from the chrystalised mass, by a gradual supply, and minute distribution of water. The last operation being alone the subject of this paper, it is needless to enter into a detail of the preceding ones, which are totally distinct from it.

The mould in common use is made in the shape of a cone, and perforated at its apex. It is placed in the fill-house in an inverted position, and filled from the coolers with the sugar partially granulated, but not sufficiently to separate the grains from the mucus; a great proportion being still held in solution by heat. In this state the mould remains all night, and in the morning is hauled up from the fill-house into a room above, where it is placed upon a pot, the apex of the cone entering the mouth of the pot. The sugar is now become cool, and forms a mass of grains and mucus; but care is taken to keep the room warm enough to prevent the too great inspissation of the mucus. The surface of the sugar at the base of the cone is made level, and having shrunk in consequence of the first running of the mucus, there is sufficient space within the mould to hold a quantity of clay, made, by a proper mixture of water, into a semifluid state, resembling

thin paste. Part of the water, no doubt, will escape from the superior surface of the clay by evaporation; but by far the greater part will be distributed over the surface, and gradually descend through an immense number of interstices, forming little currents all over the mass of sugar; thus increasing the fluidity of the mucus, and favouring its descent towards the apex, where it issues in a single stream into the pot on which the mould stands. To give a more ready issue to the mucus at the apex, a perforation is previously made in the mass by a small spear, called a pricker.

At the end of several days this clay becomes a dry cake, being deprived of its water, in the manner above described: it is then removed, and fresh diluted clay being put into its place, the operation of washing the mucus from the chrystals recommences. This is repeated, till the loaf becomes sufficiently white, when it is taken from the mould, by gently striking its edge against a block which causes the loaf to fall into the hand; being then dried in the stove, it becomes ready for consumption.

It is evident that the water contained in the clay on the base of the cone must, in descending to its apex, go on relatively increasing, in proportion to the diminishing surfaces (that is, inversely as the squares of the diameters) through which it passes, till at last it all assembles at a point and is discharged through one hole. It is also evident, that these repeated operations of washing the mucus from the grains or chrystals of the sugar, dissolve and carry off a part of the sugar itself; it is accordingly found in practice, that by evaporating the water of the fluid that had filtred through the mass, more sugar may be obtained, but the mucus will of course bear a large proportion to the grains; these sirups therefore are generally mixed with the next boiling, and so on, till they at last run from loaves of the lowest quality (called *bastards*) and finally become treacle or molasses, which will no longer granulate.

The mould which was at first full, will now contain a loaf of white sugar, the solid contents of which is not more than half of what it was originally.

Let Fig. 4. Plate III, represent the section of a mould, in the shape of those at present in use, filled with sugar; it is

evident, by inspection, that only so much of the mucus of the of the mass as does not exceed in diameter that of the hole at the apex, can descend in a right line, yet every drop in the whole mass must issue from the same aperture.

Let us suppose this mass to be divided into any number of strata;—it is evident that each stratum not only suffers the washing and consequent waste incident to itself, but must also be washed by the fluid issuing from all the strata above it. If then the water from the clay be just sufficient to wash the first stratum white, a further quantity must be added to whiten the second stra um, which has now beside its own, the colouring mucus of the first stratum increased in quantity by all the water that had been added; but this second supply of water must pass through the first stratum where it is not wanted, and here it must do the mischief of dissolving a part of the whitened sugar. The third stratum again has three times its own quantity, and thus the quantity of mucus accumulates in a series of proportionals, till the last stratum receives the colouring mucus of the whole mass, and all the water that had been added, if it be not before entirely dissolved. It must too be considered, that as the currents of mucus are descending along the sides of the cone, the loaf will constantly sink, endeavouring by its gravity always to keep in contact with the mould; and thus will be still more liable it to be dissolved by these currents.

If at the end of the operation, the loaf should be found only two thirds of its original height, one third of the number of strata must have been entirely dissolved; and as the vacant part of the mould will be at the base of the cone, the deficient strata will be those of the largest diameter; which shows a real deficiency of mass, much greater than at first sight might be imagined. It must be considered also, that the sugar thus returned to its former liquid state, will require to be evaporated by the application of great heat (no evaporation going on in the pot, its mouth being closed by the mould) which will inevitably deepen its colour; so that every operation of this sort makes the mucus darker and darker, till it becomes almost black, the known colour of molasses or treacle.

If proof of the latter fact were requisite, we need only look at the juice of the cane, which is nearly colourless, and would doubtless yield white sugar in the first instance, if the necessary operation of boiling did not make it brown.

Let Fig. 5 represent a cylindrical mould of the same base, and one third of the altitude of the conical one, Fig. 4; we know that the solid contents of these masses would be equal. It is evident then that the same quantity of sugar in the cylindrical mould would contain but one third the number of horizontal strata with that in the conical one, and consequently that the proportional series of accumulating mucus would extend to only one third the number of terms in the latter, that it did in the former case. It is evident also that every descending current would describe a right line, save only the little variations in passing round the chrystals; all the horizontal strata therefore being equal in diameter, none could receive any fluid laterally, but all would be able to support an equal quantity of water without any additional cause of dissolution, except the proportional series of the descending fluid, which, as before mentioned, would only extend to one third the number oft erms, and be unaffected with any increase from a constantly diminishing surface, as in the cone.

The plain consequence of this difference in the two masses is, that a greater quantity of undissolved sugar must be retained in the cylinder than in the cone, while the operation of whitening, that is of washing away the colouring mucus from the chrystals, is equally effected in both.

No attention is paid to the mere form of the loaf, because, as it is always broken into pieces before it can be used, the consumers would soon accommodate themselves to any one generally adopted: and for all purposes of packing, the cylindrical shape would be most convenient. But as it might be difficult to "knock out" from the mould a cylindrical mass without breaking it, so much devi tion from this shape might be adopted in practice, as would favour this operation; the frustum of a cone therefore as Fig. 6, Plate III, nearly resembling the shape of a common flower pot, is recommended. Let the smaller diameter of this mould be its bottom, to be perforated

with as many holes as the matter of which the mould is made will admit without breaking. Let a piece of leather or other flexible substance be prepared, somewhat larger than the bottom of the mould; let there be as many points or small spikes through this leather as there are holes in the mould, and so fixed that each point being within its corresponding hole when the mould is set, may be withdrawn when it is ready to be hauled up in the morning, by merely lifting the mould from it; the operator's feet being on the edges of the leather to keep it down. The mass then would be ready pricked, and this operation would be saved.

Instead of a pot, let this mould be placed over a deep dish like the bottom of a flower pot; 3 or 4 small knobs at the bottom of the mould, near the edge, would be sufficient to keep it above the mucus that would run into the dish, and leave a free circulation of air over the surface: by this means the evaporation of water from the mucus would be spontaneously going on while it is collecting, and instead of thin sirup to be boiled over again, a thick mass would be found already in part granulated.

To ascertain the reality of the improvement here proposed, the following experiment has been made.

Two moulds were prepared; one such as is in common use, with but one issue for the sirup, the other with many issues as above described. Equal quantities of sugar from the coolers were put into each, and both went through a like process in every respect. After being under clay the usual time the sugar was taken out and weighed.

The loaf of the first mould weighed six pounds two ounces, that of the second weighed seven pounds fourteen ounces, making a difference of twenty eight ounces in ninety eight; that is a saving (without any additional labour) of nearly twenty eight per cent. To this saving add the spontaneous evaporation from the surface of an open dish, which it is presumed would lessen the quantity of fluid, that would require another boiling, at least one half. The latter part of the experiment was not tried for want of convenient apparatus.

As the quantities of sugar in the moulds were determined by equal dips of a ladle only, there may have been some inaccuracy; but if the result in practice should give a saving of twenty per cent. or even less, the manufacturer will be amply repaid for changing the form of his moulds; especially as the decrease by breakage might be supplied by the new form, and thus eventually occasion very little additional expense.

No. XVIII.

An Account of some newly discovered Islands and Shoals, in the Indian Seas. By Mr. Thomas, an Officer on board the American Ship Ganges.

Read April 1st, 1803.

SHIP GANGES, Feb. 15, 1802.

AT 6 P. M. passed between two islands, lying W b N and E b S, per compass, which we supposed to be Egmont and Edgecomb islands, as seen by captain Carteret in the Swallow.

After running 25 leagues N b E ½ E, passed by nine small islands entirely covered with wood, lying in a N W and S E direction; in length about 15 leagues. These islands were not seen by captain Carteret, nor are they laid down in the charts which we had, either of Robertson or Dalrymple, nor in any chart I have since seen. Being a breast of the northermost at noon, had a very good meridian altitude;—which made us in latitude 9° 44′ S. From distances of moon and stars east and west of her, taken 14 hours after leaving the land, I should lay them down in longitude 166° 43′ E. They are of a middling height, may be seen at the distance of 8 or 10 leagues, and have no dangerous rocks or shoals in their vicinity: having run so close in with the shore as to see the natives on the beech, and their huts, with the naked eye.

Egmont Island is very erroneously laid down by captain Carteret, in 11° 00′ S. & 164° 50′ E. From my observations,